

Your Environment

STAGE 1: DESKTOP STUDY AND WALKOVER SURVEY REPORT

AT
PROGRESS GARAGE,
YAPTON LANE,
ARUNDEL,
BN18 0AS

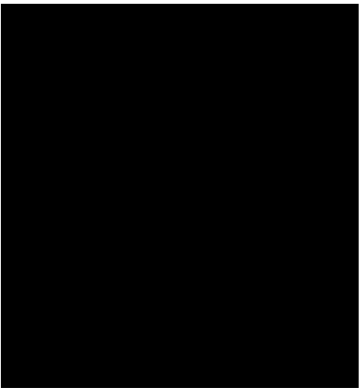
For Domusea Developments

Your Environment

Head Office, Chilgrove Business Centre, Chilgrove Park Road, Chilgrove, Nr
Chichester, PO18 9HU

Report Number: YE2690, November 2016

Kevin Brown

	Name	Position	Signature	Date
Prepared by:	Kevin Brown	Geo-Environmental Engineer		November 2016
Reviewed by:	Tristan Le Butt	Junior Geo-Environmental Engineer		November 2016
Approved:	Colin Hiscock	Director		November 2016
For and on behalf of YourEnvironment				

Issue	Date	Description	Prepared	Reviewed	Approved
01	08.11.2016	Final Report	KB	TLB	CH

Contents

1.0	Introduction	1
2.0	Site Location	1
3.0	Site Geology & Geological Hazards	2
4.0	Site Hydrogeology and Hydrology	2
5.0	Site Flood Information	3
6.0	Site Environmental and Industrial Setting	3
7.0	Historical Mapping Study	4
8.0	Walkover Survey	5
9.0	Feedback from Arun District Council	7
10.0	Summary of Possible Contamination Sources	7
11.0	Framework for Assessment of Contamination	8
12.0	Source / Pathway / Receptor	9
13.0	Qualitative Risk Assessment	11
14.0	Preliminary Conceptual Site Model	12
15.0	Proposed Site Investigation	13
16.0	Recommendations	14
17.0	Limitations and Uncertainties	15

Appendices

Appendix A - Existing Site Layout Plan

Appendix B - EnviroInsight and GeoInsight

Appendix C - Historical Ordnance Survey Maps

Appendix D - Site Walkover Photographs

Appendix E - Feedback from Arun District Council

1.0 Introduction

YourEnvironment (YE) was instructed by Domusea Developments (Quote No: Q1852, Dated: October 3rd 2016) to produce a Stage 1: Desktop Study and Walkover Report for a site known as Progress Garage which is located at Yapton Lane, Walberton, Arundel, BN18 0AS.

As we understand current plans for the redevelopment of the site are to demolish the present structures and replace with a number of residential dwellings. No proposed redevelopment plans have been forwarded to YE for review and inclusion into this report.

The purpose of this report is to accompany other documentation for the purposes of obtaining planning permission for the proposed redevelopment through the Local Planning Authority, namely Arun District Council.

An existing site layout plan, at the time of issuing this report can be reviewed within Appendix A.

Objectives

The objectives of this Stage 1 report are to:

- Establish the environmental setting, including sensitivity in relation to human health, surface water, groundwater and ecological receptors;
- Review historical and recent uses to assess the potential for contamination to be present from past and current land-use;
- Assess by qualitative means the potential nature and extent of contamination from those uses and the environmental risk and liabilities that which may affected the site redevelopment;
- Identify the prevalent source-pathway-receptor linkages present on site by means of a Tier 1 contamination risk assessment which incorporates the formulation of a Conceptual Site Model.

Information Sources

During the production of this report the following information sources have been utilised:

- A review of Historical Ordnance Survey Maps, EnviroInsight and GeoInsight information obtained from Groundsure (4C Group Ltd);
- Feedback from the Pollution Officer at Arun District Council.

2.0 Site Location

The following table outlines the details of the site:

Site address	Progress Garage, Yapton Lane, Arundel, BN18 0AS
Grid reference	497693, 105228
Total area	0.19ha
Topography	The site is situated at approximately 11mAOD
Site Layout	The site is an irregular shaped plot of land

Table 1: Site Details

3.0 Site Geology & Geological Hazards

Superficial Ground and Drift Deposits

The superficial deposits consist of River Terrace Deposits (sand, silt and clay).

Bedrock Geology

The bedrock geology is formed of the London Clay Formation, which is predominantly argillaceous, slightly calcareous, grey to bluish grey silty to very silty Clay characteristically fissured, and brown where weathered.

Natural Hazards

On site there is a low risk from shrink-swell, collapsible rocks and running sand hazards with a very low from landslides. In addition, there is a negligible risk from soluble rocks and compressible ground hazards.

Coal Mining

There are no coal mining areas within 75m of the study site.

Non-Coal Mining

There are no non-coal mining areas within 50m of the study site.

Artificial/Made Ground

There are no records of artificial/Made Ground within 500m.

Landslip

There are no records of landslips within 500m.

Faults

There is one record of a fault within 500m, which is 5m south for a fold axis which is an axial plane trace of major syncline.

Radon

The study site is not located within a Radon Affected Area, as between 1 and 3% of properties are above the Action Level. However, no radon protective measures are necessary for new properties or extensions to existing ones.

Borehole Records

There are two records of boreholes within 250m, the closest is located 51m southwest which was drilled to a depth of 130 metres.

4.0 Site Hydrogeology and Hydrology

Aquifer within Superficial Drift Deposits

As a result of the superficial geology on site the aquifer is designated as being a Secondary (A) Aquifer. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as Minor Aquifers.

Permeability of Superficial Drift Deposits

The minimum permeability is recorded as being low with the maximum permeability recorded as being high.

Aquifer within Bedrock Geology

The aquifer within the bedrock ground is recorded as being an Unproductive Aquifer. These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Permeability of Bedrock Ground

The minimum permeability is recorded as being very low with the maximum permeability also recorded as being moderate.

Groundwater Abstraction Licences

There are no active groundwater abstraction licences within 2000m.

Surface Water Abstraction Licences

There are a number of surface abstraction licences within 2000m, the closest of which is 515m south for spray irrigation.

Potable Water Abstraction Licences

There are no potable abstraction licences within 2000m.

Groundwater Vulnerability and Soil Leaching Potential

The on site soil vulnerability category is listed as being '11' this is defined as soils which can possibly transmit a wide range of pollutants.

Surface Water Features

There are no surface water features recorded within 250m.

Source Protection Zone

The study site is not located within a Source Protection Zone.

Detailed River Networks

There are a number of network entries within 500m, the closest of which is located 279m south.

Records of Licensed Discharge Consents

There is one active record within 500m, which is 395m southwest for the purposes of final/treated sewage discharge.

5.0 Site Flood Information

The study site is not within 250m of either an Environment Agency Zone 2 or Zone 3 floodplain. The risk from flooding from rivers and sea (RoFRaS) is recorded as being very low. There are no flood defences, areas benefitting from flood defences or areas benefitting from flood storage within 250m.

There are British Geological Survey (BGS) groundwater flooding susceptibility areas within 50m of the boundary of the study site which relate to superficial deposits flooding. Therefore, the highest susceptibility to groundwater flooding based on the underlying geological conditions is considered to be from a potential below surface.

The BGS confidence rating in respect of this result is considered to be high.

6.0 Site Environmental and Industrial Setting

Environmental Permits, Incidents and Registers

Sites Determined as Contaminated Land under Part IIA EPA 1990

There are no records of sites determined as contaminated land under Section 78R of the Environmental Protection Act 1990 within 500m.

Landfill and Other Waste Sites

Potentially Infilled Land

There are twenty one records of potentially infilled land within 500m, the closest of which is 266-268m northwest for ponds.

Historical/Current Land Uses

Potentially Contaminative Uses

There are fifteen records of sites with a potentially contaminative past land use within 500m, two of which are recorded as being on site for a garage. Off site, the nearest is 25m west for a nursery, with additional records 29m and 72 west for nursery's, an unspecified tank is 95m west and a nursery 99-100m south also for a nursery. Other records are over 150m away.

Records of Potentially Contaminative Industrial Sites

There are five records of sites with a potentially contaminative industrial usage within 250m, one of which is on site for a vehicle repair, testing and servicing firm, the nearest off site is a tank 73m southwest. Others feature are over 100m away.

Historical Tanks

There are thirty records of historical tanks located within 500m, the closest of which is located 70-72m southwest.

Historical Garage and Motor Vehicle Repairs

There are three records within 500m, these are all listed as being on site.

Designated Environmentally Sensitive Sites

The study site is not located upon any environmentally sensitive designations.

Information on the environmental and geological setting of the site is presented in a Groundsure EnvironInsight and GeolInsight Report prepared for the site, a copy of this report is reproduced in Appendix B.

7.0 Historical Mapping Study

The object of this search was to report on the evidence of site history and redevelopment of the site and its environs from available County Series and Ordnance Survey Maps dating from the mid to late 19th Century to the present day as downloaded from Groundsure.

Maps only represent a "snap shot" of the site and its environs at the date of the survey. Changes that had occurred either to the site and/or the environs may well not have been recorded on the maps and could represent a hazard to the site.

The information reported might not represent all pertinent information that could be obtained.

The interpretation of the maps and/or other data commented on in this report is subjective.

Year	Information
1876	The site is undeveloped and is part of a larger field, with a road running at an orientation of north-south on the eastern boundary of the site. The nearby surrounds are rural in nature, with assumed agricultural fields in every aspect. A church is located 750m northwest.
1896	There have been no discernible changes to the site and in the immediate surrounds.
1897	There have been no discernible changes to the site and in the immediate surrounds.
1910	There have been no discernible changes to the site. Off site, there is a smithy located 550m north.
1912	There have been no discernible changes to the site and in the immediate surrounds.
1939	The site has two structures of unknown usage in the central north and south portions. Off site, there are two orchards located 50m south and 50m southwest, a nursery located 110m south, and an additional nursery located 260m south.
1950	The site remains unchanged. Off site, there is a nursery located 100m west.
1961	There have been no discernible changes to the site and in the immediate surrounds.
1966	The mapping is incomplete and therefore it is not possible to ascertain if any changes have occurred on site or in the immediate surrounding environs.
1975	There is a garage located in the south of the site, and an apparent residential property labelled "The Neuk". Off site, there is a tank located 80m southwest, and 150m southwest.
1980	The site remains unchanged. Off site, there are numerous agricultural buildings ranging from 100m to 500m south.
1984	On site, there would appear to be a canopy on the extreme eastern edge, immediately adjacent to the road off site to the east. There have been no discernible changes to the immediate surrounds.
1991	There have been no discernible changes to the site and in the immediate surrounds.
1994	There have been no discernible changes to the site and in the immediate surrounds.
2002	There have been no discernible changes to the site and in the immediate surrounds.
2010	There have been no discernible changes to the site and in the immediate surrounds.
2014	There have been no discernible changes to the site and in the immediate surrounds.

Table 2: Historical Mapping Review

Therefore, from the historical maps we can consider the following:

On site sources of possible contamination:

- Various structures on unknown usage;
- Garage and associated infrastructure.

Off-site sources of possible contamination:

- Smithy (550m north);
- Various nurseries (110m and 260m south);
- Tanks (80m and 150m southwest).

The Historical Ordnance Survey Maps were obtained from Groundsure and are available for review within Appendix C.

8.0 Walkover Survey

The site was visited on October 12th 2016. The weather was crisp and bright at the time of the visit.

Access

The site is located directly to the west of Yapton Lane.

Topography

The site is flat with a very mild incline rising to the north.

Vegetation

Very little vegetation exists on site, however the boundary to the west, north and east consists of an evergreen hedgerow, and a small portion to the south is vegetated with a grass verge. An ivy shrub is found in the centre of the site.

Buildings and Structures / Floor Covering

There is the remains of a petrol station covered forecourt to the south of the site, with the main station and car show room beyond, to the west. A temporary structure acting as a security booth is found in the east of the site. To the rear (north) of the site large workshops are located.

Surface Permeability / Ground Covering

It is estimated that approximately 90% of the site is impermeable hardstanding, including the structures footprint, with 10% permeable soft landscaping around the perimeter of the site.

Drainage Features

Several drainage features were noted onsite, including interceptor traps, drain covers, and a drainage pipe running through the hardstanding at the rear.

Other Services

The workshops on the north of the site, where still in use, so it is assumed the site is still fully serviced.

Surrounds

The site neighbour's residential and commercial properties.

Direction	Description of Site boundary
North	Evergreen vegetated
East	Evergreen vegetated
South	Garage forecourt, directly onto Yapton Lane
West	Evergreen vegetated

Table 3: Summary of site boundaries

Direction	Description of Surrounding Land Use
North	Detached residential property, with associated garden area.
East	Detached residential property, being used as a hotel, with associated garden area.
South	Yapton Lane, with agricultural land beyond.
West	Large nursery

Table 4: Summary of Surrounding Land Uses

Potentially Contaminative Land Uses

On site sources:

- Garage;
- Above ground storage tanks;
- Assumed below ground storage tanks;
- Workshop, with associated paints, solvents etc. storage;
- Car storage.

Off site sources:

- Large nursery.

Photographs taken during the walkover of the site and surrounds, can be reviewed within Appendix D.

9.0 Feedback from Arun District Council

YE contacted the Environmental Health Department at Arun District Council to ascertain what information they held with regard to the status of any on site underground storage tanks.

The Pollution Officer responded to confirm that the information held was that the tanks were installed pre-1953 (License No. 488006), there were three (3no.) tanks with a capacity of 22730L. Furthermore, the tanks were made safe by slurry infilling in October 1992.

A copy of this feedback provided can be reviewed within Appendix E.

10.0 Summary of Possible Contamination Sources

The earliest mapping (c.1876) indicates the site to be undeveloped and is consists of a large plot of arable land, with a road running at an orientation of north to south on the eastern boundary, this remains to be the case until mapping of 1939 when the site is redeveloped and two structures are noted in central north and southern flanks. It is not until mapping of 1975 that the site is noted to have undergone redevelopment with a listed garage located in the south and an apparent residential property labelled as being 'The Neuk' in the north, there is also a canopy located adjacent to the road immediately east of the site. Furthermore, there two detached structures of unknown usage on the western portion of the site. These features identified from historic mapping are later observed from the walkover survey undertaken.

The immediate surrounding environs are predominately rural in nature which during the course of mapping reviewed remain largely unchanged. However, limited development mainly in the form of residential dwellings and associated garden areas are observed with notable land uses identified such as a smithy (550m north), various nurseries (110m and 260m south) and tanks (80m and 150m southwest). However, given the distances from these features to the study site they are not considered to pose a potential risk.

The walkover survey completed indicates there to be the remains of a petrol station with a covered forecourt to the south of the site, with the main station and car show room beyond, to the west. A temporary structure acting as a security booth is found in the east of the site. To the rear (north) of the site large workshops are located. Very little vegetation exists on site, however the boundary to the west, north and east consists of an evergreen hedgerow, and a small portion to the south is vegetated with a grass verge. It is

estimated that approximately 90% of the site is impermeable hardstanding, including the structures footprint, with 10% permeable soft landscaping around the perimeter of the site.

The surrounding land use are a mixture of predominately residential and commercial usage, i.e. hotel, nursery and agricultural land.

The superficial ground on site is composed of River Terrace Deposits (sand, silt and clay) which overlies bedrock geology formed of the London Clay Formation. There are no records of artificial/Made Ground within 500m and no recorded landfill sites within 2000m, however, there are twenty one records of potentially infilled land within 500m, the nearest of which is 266-268m northwest for ponds.

The hydrogeological and hydrological setting of the site is considered to be low given the presence of a Secondary (A) Aquifer within the superficial drift deposits which overlies an Unproductive Aquifer in the bedrock. There are no groundwater and potable water abstraction points within 2000m, the closest surface point is approximately 515m south. In addition, there are no surface water features located within 250m.

There are fifteen records of sites with a potentially contaminative past land use within 500m, two of which are recorded as being on site for a garage. Off site, the nearest is 25m west for a nursery, with additional records 29m and 72 west for nursery's, an unspecified tank is 95m west and a nursery 99-100m south also for a nursery. Other records are over 150m away. In respect of historical tanks the nearest is 70-72m southwest. It is noted that there are five records of sites with a potentially contaminative industrial usage within 250m, one of which is listed as being on site for a vehicle repair, testing and servicing firm. In respect of off site the nearest is a tank 73m southwest with others features are over 100m away. There are three records of historical garage and motor vehicles within 500m, these are all listed as being on site.

Feedback received from the Environmental Health Department at Arun District Council by YE regarding the status of any on site underground storage tanks indicated that tanks were installed pre-1953 (License No. 488006), there were three (3no.) tanks with a capacity of 22730L. Furthermore, the tanks were made safe by slurry infilling in October 1992.

Based on the foregoing, we have identified potential sources of contamination which relate to historical/current land uses on site, i.e. garage, associated infrastructure, underground storage tanks and namely the vehicle repair, testing and servicing workshops, with the storage and usage of associated chemicals. Furthermore, potential cement bonded roofing material was also observed. Therefore, we would recommend a site investigation be undertaken to determine the actual risks these potential sources may pose to various receptors identified in the following section.

11.0 Framework for Assessment of Contamination

Environmental risks are assessed within the risk management framework established in Part IIA of the Environmental Protection Act (EPA) 1990 introduced by Section 57 of the Environment Act 1995 which provides a statutory definition of contaminated land. To fall within this definition it is necessary that, as a result of the condition of the land, substances may be present on or under the land such that:

- (a) *Significant harm is being caused or there is a significant possibility of such harm being caused;*

or

(b) *Pollution of controlled water is being, or is likely to be caused.*

Risk from contamination is assessed by consideration of possible linkages between contaminant sources and potential receptors which could be harmed or polluted.

The key aspect of the framework is the development of a Conceptual Site Model (CSM) which illustrates the spatial interaction between the potential sources and receptors on site.

The information presented in this report was collated and evaluated to develop an initial CSM to assess ground contamination issues at the site.

For a risk of pollution or environmental harm to occur as a result of ground contamination, **all** of the following elements must be present:

- A source, i.e., a substance that is capable of causing pollution or harm;
- A receptor, i.e., something which could be adversely affected by the contaminant;
- A pathway, i.e., a route by which the contaminant can reach the receptor.

If one of these elements is absent there can be no significant risk. If all are present then the magnitude of the risk is a function of the magnitude and mobility of the source, the sensitivity of the receptor and the nature of the migration pathway.

Potential sources, pathways and receptors are identified in the sections below and the risks associated with possible pollutant linkages outlined.

12.0 Source / Pathway / Receptor

Sources

The **main sources** of potential contamination that have been identified at the site or in the vicinity of the site are summarised above and below:

Source	Location	Description
Historical/current activities associated with the garage associated infrastructure, underground storage tanks and namely the vehicle repair, testing and servicing workshops, with the storage and usage of associated chemicals.	On site	Potential for localised contamination from historical and current land uses on site such as Hydrocarbons (TPH, PAH, BTEX, MTBE), heavy metals, asbestos, SVOCs and VOCs.
Made Ground (soil gas generation).	On site	Possible Made Ground may be identified as a result of limited historical development.

Table 5: Sources

Receptors

The site specific **receptors** that could be potentially affected by the contamination hazards identified during this preliminary appraisal are summarised below:

Category	Receptor	Properties
Humans	End users and visitors	Discrete areas of soft landscaping if they are to be incorporated into the proposed redevelopment. In addition, there may be a risk from volatilisation of hydrocarbons from activities associated with the sites historical use as a garage and from current use as vehicle repair works.
	Construction workers	Reworking of potentially impacted materials in soils during construction works can expose workers to contamination.
Property	Materials and site structures	Foundations and site services may be damaged by potentially aggressive compounds present in soils.
Controlled Waters	Underlying superficial / bedrock aquifer and surface water.	The site is recorded as having a Secondary (A) Aquifer within the superficial drift deposits which overlies an Unproductive Aquifer in the bedrock. There are no groundwater and potable water abstraction points within 2000m, the closest surface point is approximately 515m south. In addition, there are no surface water features located within 250m.
Plant (species and uptake) and Wildlife	Various	Attributes will be influenced by factors such as relative quality, scale, rarity and substitutability.

Table 6: Receptors

Pathways

In order for contaminants to reach potential receptors, there has to be a viable **pathway** for the contaminant. Potential pathways that may affect the migration of contaminants are listed below:

Pathway	Medium	Properties
Direct Contact	Dust, solid and liquid phase	There is a possibility of dust fumes being produced during earthworks in the demolition and construction phase. Dermal contact and ingestion of potentially contaminated soils during construction or operational phase of the site.
Leaching through Made Ground	Unsaturated flow	Potential for leaching and migration of potential contaminants along preferential flow paths in the Made Ground due to its heterogeneity.
Foundations and Underground Infrastructure and Obstructions	Preferential flow	Depending on the foundation solution adopted, preferential flow paths for the vertical migration of potential contaminants to the underlying groundwater could be created.
Migration of Ground Gas	Gaseous flow	Made Ground is known to be highly variable in composition. Migration through granular material in Made Ground and alongside buried utility pipes / cables or along preferential flow paths.

Table 7: Pathways

13.0 Qualitative Risk Assessment

Potential pollutant linkages are identified using the source-pathway-receptor framework detailed above. An assessment of the potential significance of each linkage is then made by consideration of the likely magnitude and mobility of the source, the sensitivity of the receptor and nature of the migration/exposure pathways.

This qualitative risk assessment has been undertaken in accordance with CIRIA C552: Contaminated Land Risk Assessment, A Guide to Good Practice (Rudland et al., 2001).

An assessment of the likelihood of the risk being realised and the magnitude of potential risk is presented below to give an estimation of the significance of each potential pollutant linkage Identified.

The assessment is undertaken based on the current proposals for the site, at the time of issuing this report and therefore would be classed as a generic end land use of 'residential'.

14.0 Preliminary Conceptual Site Model

Hazard / Pollutant	Pathways	Receptor	Potential Severity	Probability of Risk	Level of Risk	Justification
Hydrocarbons (TPH, PAH, BTEX & MTBE), Heavy metals, SVOCs, VOCs and asbestos.	Ingestion, dermal contact, inhalation	Future end users, site visitors and site visitors	Medium	Low Likelihood	Moderate	A moderate risk is considered given the historic/current setting of the site combined with the proposed generic end land use of 'residential' which is assumed to feature areas of soft landscaping.
		Construction Workers	Medium	Likely	Moderate	A moderate risk is considered given the historic/current setting of the site and surrounding environs. Construction workers are likely to come into direct contact with soils during groundworks therefore the use of appropriate PPE should be adopted to mitigate against any potential risks.
	Leaching through soils and migration via groundwater or soil pore moisture	Controlled Waters	Medium	Low Likelihood	Low	A low risk is considered given the site is recorded as having a Secondary (A) Aquifer within the superficial drift deposits which overlies an Unproductive Aquifer in the bedrock. There are no groundwater and potable water abstraction points within 2000m, the closest surface point is approximately 515m south. In addition, there are no surface water features located within 250m.
	Uptake	Plant and Wildlife	Mild	Low Likelihood	Moderate	A moderate risk is considered given that the proposed development which is assumed to incorporate areas of soft landscaping.
Ground Gases.	Gas generation, migration and build up within properties	Future end users, site visitors, site workers and proposed site structures.	Medium	Low Likelihood	Moderate	A moderate risk given the potential for ground gases and volatilisation of hydrocarbons to transport through the superficial deposits from on site historical garage and current workshops.

Table 6: Preliminary Conceptual Site Model

The risk posed to future end users & site visitors, construction workers, proposed development and plant & wildlife has been estimated as MODERATE with the risks to controlled waters estimated as being LOW.

15.0 Proposed Site Investigation

Based on the information obtained for formation of this report, we would recommend that an intrusive contaminated land investigation is undertaken to determine the actual pollution linkages and to quantify the risk to the receptors as outlined with the Preliminary Conceptual Site Model. It may also be prudent to undertake geotechnical assessment at the same time as the contaminations, for the proposed development to prevent additional mobilisation costs being incurred.

The intrusive investigation may reveal on-site sources of contamination that were not established by the Phase I Desk Study and Site Walkover and thus require modification of the conceptual site model.

15.1 Testing Regime

The testing regime has been devised in accordance with BS10175:2011 Guidelines for the Code of Practice for Contaminated Land and CLR Report No. 4 Sampling Strategies. The objective at this stage of the report is to attempt to delineate the extent of any possible contamination that may exist at the site by using intrusive soil sampling and testing techniques.

15.2 Sampling Strategy

A service search should be completed prior to any subsequent investigation to determine the service locations by lifting up any manhole/drain covers and the use of a Cable Avoidance Tool (CAT), therefore locations may be subject to change depending upon these results.

The SI should incorporate the drilling of five (5no.) window sampler boreholes in order to gain a suitable spread of the site and enable adequate analysis of the soil conditions. This will be completed to a maximum depth of 4-5 metres below ground level (mbgl) or refusal or where groundwater is encountered.

All positions should be logged and samples removed in accordance with current protocol. In addition, groundwater conditions, if encountered, shall be logged and visual/olfactory observations noted.

We would recommend that three (3no.) of the windowless sample holes are installed with gas monitoring standpipes in order to quantify potential gas and groundwater risks.

We would recommend that the test locations be based on the findings contained within this report and that the sample locations have been located to provide a broad coverage of the site as feasibly possible.

15.3 Monitoring Regime

The installed positions should be monitored for ground gases and groundwater, monitoring will commence approximately 7-10 days after completion of the holes to enable equilibration of the underlying soils and groundwater. Monitoring will be completed on a weekly basis on three (3no.) occasions.

Gas monitoring should be completed in accordance with CIRIA C665 *Assessing Risks Posed by Hazardous Ground Gases to Buildings*, when atmospheric pressure is either falling and/or below 1005 millibars (mb).

A portable Gas Analyser (GA2000+) should be used to monitor soil gases (Oxygen, Carbon Dioxide, Methane and Hydrogen Sulphide) within the positions. A Photo Ionisation Detector (PID- MiniRae 2000 lamp 10.6eV) meter should also be used during monitoring rounds to analyse the presence of Volatile Organic Compounds (VOCs) as a matter of course.

Once gas monitoring has been completed, a dip meter will be used to test for groundwater depth.

15.4 Laboratory Analysis

An appropriate and consistent analytical suite of contaminants should be applied to any soil samples retrieved from the site.

Based on the findings contained within this report, we would recommend that a comprehensive range of testing should be undertaken to comprise of heavy metals, speciated Total Petroleum Hydrocarbons (TPH CWG Aromatic/aliphatic split) and speciated Polycyclic Aromatic Hydrocarbons (PAH) including the more carcinogenic benzo(a)pyrene (BaP) and naphthalene, BTEX, MTBE, SVOCs, VOCs, phenols, soil organic matter (SOM) content, pH and sulphates.

In addition, selected samples retrieved from the Made Ground, if encountered, will also be submitted for a screen to determine the presence, or otherwise, of asbestos.

A UKAS and MCERTS accredited laboratory testing organisation will carry out all analysis.

15.5 Guidance

The results from the proposed SI shall be compared against standards, such as, against revised LQM/CIEH S4UL criteria¹ where available. These GAC have been designed for use under planning, using Health Criteria Values based on minimal risk, and updated exposure parameters. The S4UL are intended to replace the previous LQM/CIEH GAC. Or alternatively criteria such as, Soil Guideline Values (SGVs) and LQM 'CIEH' Generic Assessment Criteria for the land use classification appropriate to the proposed end use, namely; 'residential'.

Results from gas monitoring shall be used to calculate a Gas Screening Value (GSV) in accordance with CIRIA C665 '*Assessing Risks Posed by Hazardous Ground Gases to Buildings*'.

16.0 Recommendations

16.1 Consultees

¹ Nathanail et al. (2015) The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, 2015. Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3495

We would recommend that this report be forwarded to the relevant planning authority prior to commencing with the proposed SI in order to seek their comments and subsequent approval.

16.2 Soakaways

Soakaways are for the disposal of clean uncontaminated surface water only and must not be constructed in contaminated land, or land suspected of having contamination present.

16.3 Flood Risk Assessment

This report does not replace a full hydrogeological survey and specialist studies may need to be undertaken to ascertain the risks posed from flooding.

16.4 Asbestos Survey

We would recommend that an asbestos survey is carried out for the buildings on site, prior to their demolition. If any asbestos containing material (ACMs) are identified within these buildings they will need to be dealt with in accordance with current guidance.

17.0 Limitations and Uncertainties

This report has been prepared by YE with all reasonable skill, care and diligence. The work undertaken to provide the basis of this report comprised a study of available documented information from a variety of sources, together with a site walkover inspection of the site.

The opinions given in this report have been dictated by the finite data on which they are based and are relevant only to the purpose for which the report was commissioned.

Information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data with respect to site conditions. Should additional information become available which may influence the opinion expressed in this report, YE reserves the right to review such information and, if warranted, to alter the opinions accordingly.

It should be noted that any risks identified in this report are perceived risks based on the information reviewed; actual risks can only be assessed following a physical investigation of the site.

The 'vicinity' of the site for the purposes of the report, is defined as locations situated within an approximate 250m radius of the site, although certain sources of contamination and/or sensitive targets further than 250m from site have also been included.

The recommendations contained in this report represent our professional opinions. These opinions were arrived at in accordance with currently accepted industry practices at this time and as such do not guarantee that the sites are free of hazardous, or potentially hazardous materials, or conditions.

This report has been prepared solely for the use of the named client, and may not be relied upon by other parties without written consent from YE. YE disclaims any

responsibility to the client and others in respect of any matters outside the agreed scope of the work.